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NEUTRON IMAGING FROM A MUSEUM PERSPECTIVE

Over the last 30 years, scientific analysis of cultural objects has become increasingly established in areas such as archaeology and conservation. This has led to the creation of an entire new discipline, archaeometry, which develops and adapts analytical techniques for example in the fields of scientific dating, dietary studies, provenance studies and technological analysis of objects. The impact of these studies on modern archaeological research can hardly be overestimated.

In conservation, scientific methods such as X-radiography or materials analysis are today routinely used for diagnostic purposes prior to any interventive measures, as well as for monitoring and improving treatment procedures, materials and techniques.

Scholars in other areas have also started collaborating with scientists, albeit often at a much slower speed. Art historians still by and large rely on their trained eye for the study of paintings, even though paintings conservators have already for some considerable time adopted scientific analysis as a routine aid to their work. Numerous recent forgery scandals where science proved the inconsistency of materials used in fake paintings with their presumed date have demonstrated the limitations of traditional art historical appreciation left on its own.

Scientific analysis can also tell us more about the geographical and cultural origin of objects when the original context has been lost, a common problem with archaeological or ethnographic objects acquired through the art market. Various scientific dating methods and materials characterization techniques have proved useful to this effect.

Despite these examples of successful collaboration between science and humanities, relatively few researchers and institutions truly manage to bridge the gap. For many art historians and archaeologists their career choice reflects a personal preference for the humanities, and many scientists lack the in-depth level of knowledge of archaeology or art necessary to understand their research issues.

Conservation science laboratories do exist in some of the bigger museums, but they are all too often fully occupied by internal projects and unable to take on external work. University scientists associated with conservation degree schemes may sometimes be able to help. In addition, there exist a few highly competent commercial or semi-commercial laboratories for the scientific analysis of works of art, for whom time is money and who simply cannot afford to take on an educational role in the promotion of scientific research in the humanities. Despite the basic scientific training archaeology and conservation students receive today at university level; their opportunities to translate this knowledge into professional practice remain limited.

In this situation, an initiative by the scientific community to make their instrumentation available for the analysis of works of art must be welcomed. However, bringing together scientists with their colleagues from the humanities in a joint project remains a challenge because either side has a long way to go. It is the aim of this paper to explain to the scientific community how museum staff usually work, where their interests lie, and what their possible part in a collaboration might be.

Research in a museum

Museums generally pursue three principal types of activities: education, conservation of their collections, and research, with priorities usually ranking in this order. All three activities have to be understood in the widest possible sense.

Education involves organizing visitor programmes for all types of audiences. School parties ranging

from small children to young adults make up an important part of total visitor numbers in most museums. Tourists, families and special needs groups are also increasingly targeted. Special events such as children's birthday parties, corporate events or late night openings are important for the public image of an institution; they occupy significant staff time without being research-related at all.

Conservation is a typical background task in the life of a museum. 95-99 % of the collections of a typical museum never go on display but remain in storage indefinitely, only ever to surface in the occasional temporary exhibition held by the home institution or on loan elsewhere. Few people outside the museum community realize that what is on public display does not even represent the tip of the iceberg. All objects must of course be conditioned and stored properly, entered into the inventory, inspected at regular intervals for signs of deterioration, and made available to visiting researchers if required. Visitors get an occasional glimpse of these activities at open days or behind-the-scenes tours, but otherwise they pass largely unrecognized by the public.

Practical conservation presents an opportunity to investigate objects and to make technological observations within the usually quite strict limits of time and resources available. More often than not, the conservators' workload is such that they have to restrict themselves to documenting observations and hypotheses unless the questions are directly relevant to the treatment. Whether any scientific analysis can be carried out at all in conservation largely depends on the convenient availability of the necessary infrastructure, as well as on the personal interest and knowledge of the conservator in charge. Few museums have the means to do scientific analyses in-house, and systematic investigation is usually impossible but for a few exceptional objects.

Research, the third element of a museum's core programme, comprises all activities designed to learn more about the history and cultural context of the objects. Even though scientists would immediately think of scientific analysis, this is in effect not at all the most common type of research in a museum. Historical research, archaeological excavations, comparative studies of objects in other collections, or ethnographic field trips all fall under this heading.

Scientific analysis of cultural objects in fact only represents a fraction of the total research activity undertaken by museum staff. A nuclear scientist looking to establish a research collaboration with a museum should be fully aware that neutron imaging is a fringe technique within conservation science, which in itself remains very much on the margin of museum activities.

Neutron beam time may be extremely precious to scientists whose primary occupation is pure or applied research. This appreciation is unlikely to be shared by museum curators and conservators who have different priorities even if they do understand the potential of neutron techniques for the investigation of their objects, specialist knowledge which can by no means be taken for granted. Scientists should therefore not be surprised or disappointed when they receive no more than a lukewarm response in reply to a generous offer of valuable neutron beam time.

Collaborating with a museum

Experience shows that examples of successful collaboration between a museum and a neutron imaging institution often results from personal contacts between a nuclear scientist and a conservator or a curator with a particularly open mind towards scientific analysis. Most conservators have received at least some basic scientific training, and through their work, they are familiar with the materiality of the objects. The curator, however, is usually the person best acquainted with the cultural context of the objects in his charge. He would be able to formulate relevant questions to be answered. If one person does not respond positively to an offer for collaboration it may well be worth trying a different person from the same institution who may be more responsive. It helps, as always, if the approach targets the potential user's needs and interests.

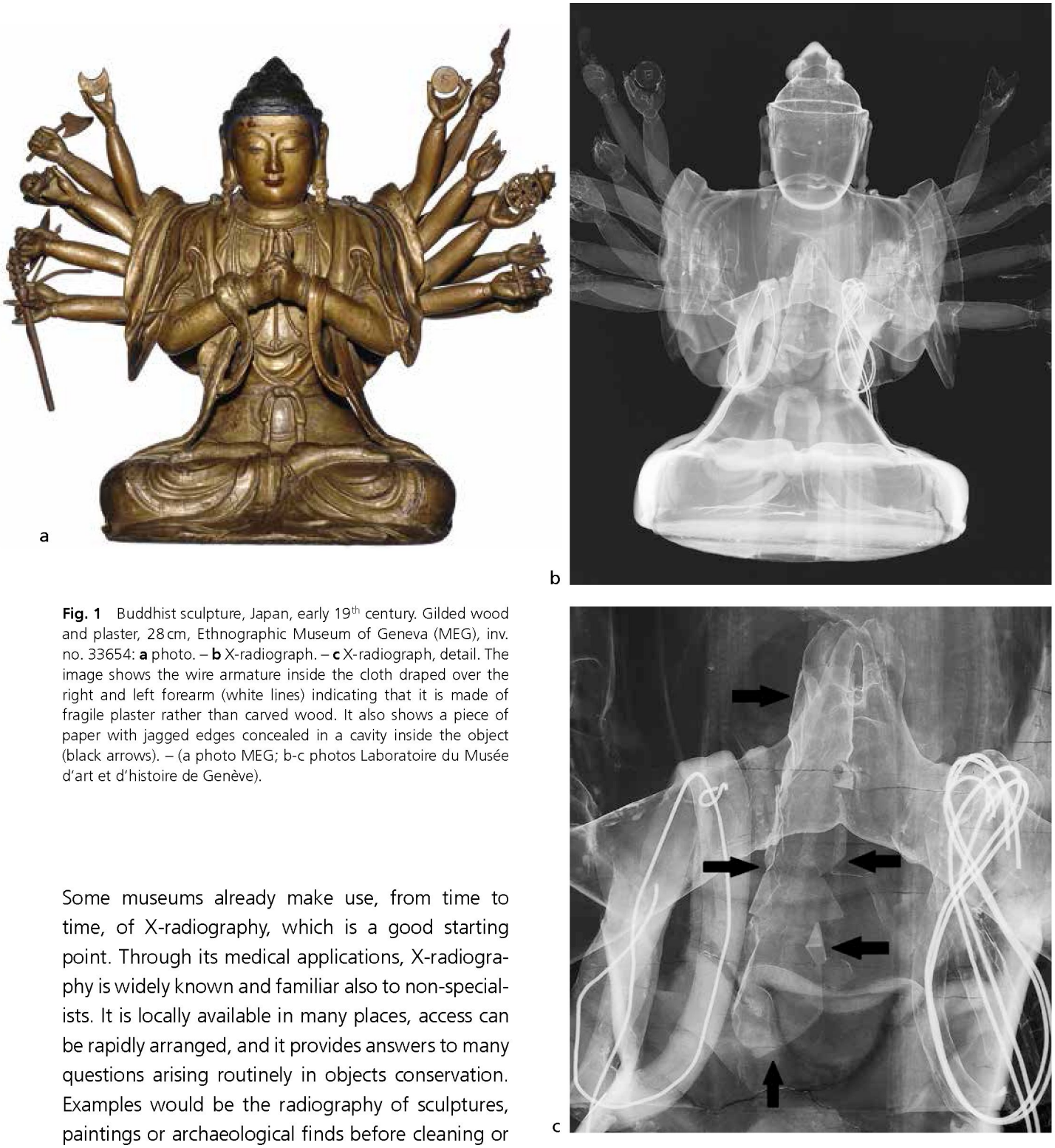

Fig. 1 Buddhist sculpture, Japan, early 19th century. Gilded wood and plaster, 28 cm, Ethnographic Museum of Geneva (MEG), inv. no. 33654: **a** photo. – **b** X-radiograph. – **c** X-radiograph, detail. The image shows the wire armature inside the cloth draped over the right and left forearm (white lines) indicating that it is made of fragile plaster rather than carved wood. It also shows a piece of paper with jagged edges concealed in a cavity inside the object (black arrows). – (a photo MEG; b-c photos Laboratoire du Musée d'art et d'histoire de Genève).

Some museums already make use, from time to time, of X-radiography, which is a good starting point. Through its medical applications, X-radiography is widely known and familiar also to non-specialists. It is locally available in many places, access can be rapidly arranged, and it provides answers to many questions arising routinely in objects conservation. Examples would be the radiography of sculptures, paintings or archaeological finds before cleaning or treatment. X-ray images typically show earlier restorations dissimulated by retouching, technological details such as precious metal features, concealed structures inside an object, or internal damage (fig. 1a-c). Sometimes conclusions as to the age, origin or authenticity of an object can be drawn.

Neutron imaging often competes poorly with X-radiography as far as practicalities are concerned. Unless a museum is fortunate to be situated near a nuclear research reactor, medium to long distance travel

with the object will be required. Even western industrial countries rarely dispose of more than one such facility, the only in Switzerland being the Paul Scherrer Institute at Villigen (AG) some 270 km from Geneva. Applications for beam time must generally be made several months in advance in a competitive procedure, which rules out spontaneous projects derived from chance observations during conservation work. Possible nuclear activation during analysis means that to comply with radioprotection requirements some objects may have to remain within the controlled zone at the nuclear research compound for up to several weeks. This becomes particularly an issue for neutron tomography where relatively high doses are administered, and for certain metals such as silver.

All this does not rule out the use of neutron imaging for a museum, but it complicates the procedure significantly and increases the cost to the institution in terms of time and money. It is obvious from the above that for routine investigations museums are well advised to try X-radiography first. In the relatively rare cases where this proves unable to answer their questions it can be justified to consider neutron imaging as an alternative option, but the project will then rapidly take on an altogether different dimension in terms of necessary time and resources.

Especially in case of smaller museums a neutron-imaging specialist making contact to establish a collaboration may well be the first and only scientist available to advise museum staff on possible scientific strategies to address their questions. In many cases, techniques other than neutron imaging may be more appropriate and sufficient to give a result. To provide competent advice any scientist looking to collaborate with cultural heritage institutions therefore should at least to some extent be familiar with general aspects of conservation or archaeological science. This includes the ability to interpret the images or other analytical results from his work in a cultural context.

All too often curators or conservators are persuaded to provide objects for neutron imaging tests with the vague aim to find out whatever new information the technique can possibly give. The answer is unlikely to be satisfactory because unless a precise and focused question is asked, chances are that the result is of little scientific interest to anyone. A neutron image without proper interpretation and relevant conclusions is not worth the effort and amounts to a waste of precious resources.

Other neutron-related analytical techniques carry the potential for similar disappointment. Take for example neutron activation analysis to determine the elemental composition of an ancient coin. To be useful, the result that could in most cases be much more easily obtained by alternative techniques such as X-ray fluorescence analysis, analytical scanning electron microscopy or laser ablation ICP-mass spectrometry anyway, must be interpreted in its historical context. Simply handing over a result to the museum in the form of a list of analytical percentages leaves the most important part of the work still to be done. The real contribution of a scientist always lies in the full interpretation of his results rather than mere data acquisition, which could in many cases be carried out by a sufficiently experienced technician. Any scientist embarking on a collaboration with colleagues from a different subject area remains responsible not only for the integrity of his results but also for their interpretation. In order to fulfil this role he must make sure to have fully understood the question and its significance in archaeological, art historical or conservation terms. It is then his responsibility to set up an experiment likely to provide an answer. This usually implies a considerable effort to read and review literature from other domains than his own.

Conclusions

Most museums require a lot of guidance when it comes to the application of novel scientific techniques such as neutron imaging to the study of cultural objects. Unless the project scientist is familiar with the relevant archaeological, art historical or conservation literature and research topics, there is a genuine risk that costly neutron beam time will be wasted on experiments which do not bring about

any real scientific benefit. Because scientific and/or technological research cannot be prioritized by most museums in competition with pressing day-to-day activities such as organizing exhibitions and educational activities, it usually works best for a nuclear scientist to propose a specific project when trying to attract the interest of a museum, rather than simply to request input on their part. It is important for the scientist also to be able to provide general advice to the museum on scientific analysis of cultural objects. This includes the use of other methods and techniques than his own. All too often sophisticated and expensive analytical methods are used when a perfectly valid answer could already be obtained by much more simple means such as X-radiography, optical microscopy or X-ray fluorescence analysis.

Practical experience shows that truly successful collaboration between science and a museum is rarely possible without a significant effort on the part of the scientists to broaden their horizon well beyond their own subject area. Doing this enables the scientist not only to acquire genuinely useful data but also to interpret his results in a cultural context and in a language accessible to colleagues in the humanities.

Summary / Zusammenfassung

Neutron Imaging from a Museum Perspective

Research is one of the three principal activities of a museum, besides education and conservation of the collections. All three have to be understood in the widest possible sense. Scientific research on the objects would in turn only represent a relatively small part of a museum's overall research activities, the focus being usually on historical, art historical, archaeological or other research directly in line with the museum's subject area. Neutron imaging and analysis of cultural artefacts are relatively new methods and only represent therefore a marginal technique on the fringe of a museum's activities. Why would under these circumstances neutron imaging be interesting to a museum? This paper presents examples from the Geneva Ethnographic Museum illustrating how looking inside an object contributes to our understanding of the museum's collections, and where, despite the exceptional logistical effort required for the analysis, neutron imaging becomes important or even indispensable.

Neutronenbildgebung oder Neutron Imaging aus der Perspektive eines Museums

Forschung ist neben der Ausbildung und der Erhaltung der Sammlungen eine der drei Hauptaktivitäten eines Museums, die alle im weitesten Sinne verstanden werden müssen. Die wissenschaftliche Forschung an den Objekten macht wiederum nur einen kleinen Teil der gesamten Forschungsaktivitäten eines Museums aus, während der Fokus normalerweise auf historischer, kunsthistorischer und archäologischer Forschung liegt oder einer Forschung, die direkt mit dem Sammelgebiet des Museums in Verbindung steht. Neutron Imaging und die Untersuchung von Kulturgütern sind relativ neue Methoden und repräsentieren daher eine nur selten verwendete Technik am Rande der Aktivitäten eines Museums. Warum sollte unter diesen Umständen Neutron Imaging für ein Museum interessant sein? Dieser Beitrag nennt Beispiele aus dem Ethnografischen Museum Genf, die zeigen, wie der Blick in das Innere eines Objekts zu unserem Verständnis der Sammlungen des Museums beiträgt, und wie Neutron Imaging trotz des damit verbundenen außerordentlichen logistischen Aufwands für die Untersuchung wichtig oder sogar unentbehrlich wird.

Keywords

X-radiography / neutron imaging /
interdisciplinary collaboration / museums